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Objective Animal Experiments

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"Science teaching has long concerned itself chiefly with the mastery of laws, facts, and principles to the neglect of certain of the less tangible, but none the less desirable outcomes, such as attitudes of mind."[1] Not to make biology functional is a grave error on the part of any teacher, for the high school graduate today is faced with a world far more complex than that which confronted his parents or grandparents. True, we do not advertise our schools as the panacea for unemployment and award a position with each diploma, nor should we, but we *should* develop in students certain attitudes and mind-sets that will lead to better social adjustment and enrichment of life.

The fact that every once in a while some pupil asks, "Why do I have to take geometry?" or "Why must I take biology; I don't see where it is doing me any good?" indicates that the course in question has not been made functional for him. Of course it will be some years before pupils realize the value of certain high school courses, if at all, but that teacher fails indeed who fails to point out—verbally or otherwise—from day to day the things that his course can do for his students.

It seems to me that science teaching should ingrain in the mind of the student something more lasting than mere facts relative to biology, physics, or chemistry, and with this thought in mind I have cast about for a single objective around which to build an experiment that would run for several months. My primary concern was to pick an objective that, once attained, would benefit a student for the rest of his life. The Scientific Method of Problem Solving was finally chosen as the main objective, for many of the facts taught in biology courses are forgotten by the average student soon after graduation, if not before. Several educators strongly sus-

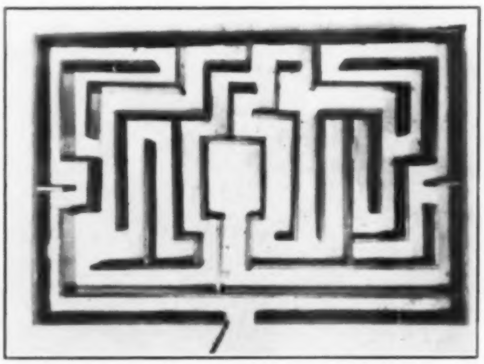
[1] Heiss, E. D., Obourn, E. S., and Hoffman, C. W., "Modern Methods and Materials for Teaching Science," Ch. 2, p. 15. The Macmillan Company, New York, 1940.

pect that under the present laboratory system the Scientific Method is not "fixed" in the student mind and does not carry over into life situations. However, if given a chance to apply the Method repeatedly and over a considerable period of time to a real live problem, not just another laboratory exercise, students may graduate with something more tangible and useful than a few hazy conceptions of scientific fact and law. They will have a lasting, reliable, keen-edged tool with which to attack their daily problems. The fact remains that the Scientific Method must be taught as an objective if our students are going to "get" it, and I feel that they must, for it will be one of the most valuable contributions a study of biology can make to their lives.

A second objective for this work is to convince students that their course in biology is a definite help to them in life *now* and not merely a passive appendage to their general education. The following account will explain an experiment devised to attain the above desired results. With the chosen objectives constantly in mind three experiments have been carefully planned and executed here for three years. They were built around animals, as children have an inherent fondness for them that can't be suppressed, even though the animal selected is the common white rat. They are also excellent aids in dispelling many myths regarding animal behavior. The experiment selected from the three referred to for discussion in this paper deals with the learning processes of white rats. It must be mentioned that careful motivation throughout the entire experiment is the keynote of success.

Having studied habit formation, touching slightly on the Laws of Learning, the class was given an opportunity to experiment with learning processes of animals. They were all in favor of the project and elected two students from each of our four classes to act as Chief Experimenters. The duties of the Chief Experimenters were to conduct the experiment and see that the animals were fed and the cages cleaned. They were authorized to delegate work to other members of the classes, and were required to report to the classes from time to time. One of the students, interested in woodworking, constructed a very good Hampton Court maze (see figure) of the type frequently used in psychology experiments. Needless to say this student was greatly pleased to see his maze in use, and has been constantly interested in the experiment. The interest and cooperation of other students was gained by encouraging them to make cages for the project.

After much discussion, carefully planned on the part of the teacher, the classes became aware of certain variable factors they would have to control; and consequently, in order to minimize hereditary differences, chose for experimentation four white rats that came from the same litter. They decided that differing ages, amount of food available,



THE HAMPTON COURT MAZE
Note the door at bottom center, for admittance of animals and the square food chamber directly above. The top is covered with removable glass.

and even sex might influence the rate of learning. As one boy put it, "Perhaps we can find out whether or not females learn faster than males," and as a result two of our animals had to be females and two males. It is through work of this nature that students are given an opportunity to weigh and evaluate factors involved in the correct solution of problems.

The experiment, begun in October, lasts until the first of May with the animals being run through the maze every other day. They are allowed no food during a day on which they are to perform, but on all other days are fed at three o'clock P.M. The recorded data consist of the following:

1. Time taken to solve maze.
2. Blind alleys investigated.
3. Blind alleys entered.
4. Blind alleys ignored entirely.
5. Time used in eating when food has been found at end of maze. (All timing is done with a stop watch.)

At first each animal took over an hour, but the Chief Experimenters would not listen to the idea of taking one out before it had solved the maze. Our discussion of variable factors was already paying dividends. At the present time all animals are going through in less than thirty seconds and the females seem to be learning faster than the males as their time is usually several seconds better. These facts are brought to the student's attention and give the instructor an excellent opportunity to point out that, with only two animals of each sex under experimentation, slight differences are of no statistical significance. General laws must be confirmed with numbers large enough to eliminate chance variations. Over a period of years such numbers will be obtained, for we plan to conduct this experiment every year, not so much for its scientific value as for its educational value in training students to use the Scientific Method.

Before the experiment is finally concluded in May the subjects are given a period of one month, during which no trials are run, for the students, familiar with the Law of Disuse, wish to discover how fast their rats forget, and which sex, if either, forgets faster. After renewing trials to obtain the above data the experiment will be brought to a close. All data will be graphed, charted, and discussed; and a thesis will be written by the entire class, which will set forth our Object, Materials, Method of Procedure, and Conclusions. Students are quick to see the practical applications of such an experiment, and never has one of these theses failed to point out the advantage to students of following the Laws of Learning in their daily studies and the difficulties met in studying by the hit or miss, trial and error method, at first used by the rats. Invariably at the end of this work we get into a discussion of habit formation, and students inquire, "How can I improve my study habits?" This gives the teacher a chance to do some much needed remedial work with individuals, and at the same time convince them of the value of applied biology.

If the only outcome of our experiment should be an improvement in student methods of study, our time and effort will have been well spent, for most of the students are sophomores with two years remaining of high school and a possibility of four years in college.

It is not enough to discuss the Scientific Method at the start of this work, it must be stressed at every opportunity, and especially at the end of experimentation, repeatedly driving home the fact that once learned this Method can be used to attack *any* problem as well as the problem of animal behavior. In the final analysis, as in all teaching, whether or

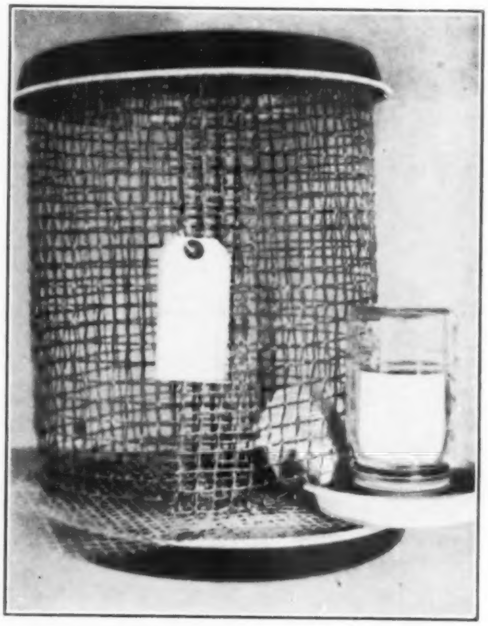
not such a project is successful and the desired objectives attained depends almost entirely upon the teacher. One of the most valuable outcomes of this experiment is the idea that conclusions based on factual data and carefully controlled experimentation are much more trustworthy and valuable than are conclusions based on any other premise.

A teacher must give much time and careful thought to put over a project of this type, but he will receive his reward throughout the entire experimental period. It is certainly gratifying to observe the keen interest taken by students in their animals and to hear them discussing a day's results after class or in the halls—and don't think they fail to compare their learning ability with that of the rats. It is also interesting to hear the questions of students not taking biology when they visit the laboratory, and the sound, accurate answers they usually receive from students in charge of the animals.

These experiments require no expensive or intricate equipment that might prohibit their use in the smallest or poorest school. For our stock rats and those under experimentation, except those used in nutrition experiments, we use the diet worked out by the Bureau of Home Economics, United States Department of Agriculture, Washington, D. C., which follows:

1. Whole wheat (ground fine)—1600 grams.
2. Whole milk (powdered)—800 grams.
3. Table salt—32 grams.

Inexpensive cages can be constructed from a piece of galvanized wire screening, three squares to the inch, 36″ × 12″, and two pans or round trays approximately 10″ in diameter. Fold one narrow end of the screen forward two inches and the opposite narrow end backward an equal amount. Interlock the



The above cage cost less than fifty cents.

folded ends to form a cylinder and hammer down the ends of wire to make them firm. Fill one of the trays with sawdust and place over it a square of wire 11″ × 11″ to keep animals from scattering the sawdust. Now place the cylinder on top of the wire and you are ready for a tenant. The other tray, of course, is used as a top for the finished cage. Such cages are inexpensive and can be made in square or rectangular form if desired.

A Third of a Century in Biology Teacher Education

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At the beginning of the present century there arose in the United States a group of men eminent in their respective fields who turned their attention to the teaching of biology in the elementary schools and the high schools. Huxley in England had devoted many of his writings and public addresses to the place of biology in education. His essays and lectures should be made the Bible of all young biology teachers. They give inspiration and purpose to science teaching. David Starr Jordan, biologist, biological philosopher, university president, and international diplomat, was spreading the gospel of biology teaching in this country. His little book, *Reality and the Conduct of Life* should be familiar to all who wish to gain a vision of the purposes, aims, and methods of biology teaching. John M. Coulter and Bradley Moore Davis at the University of Chicago, and Besse at the University of Nebraska were concerning themselves with botany at the high school level and with nature study in the grades. Liberty Hyde Bailey and the Comstocks at Cornell University, and C. F. Hodge at Clark University were promoting nature study in the grades.

At this time I was a student, first at the University of Chicago, then at Indiana University, and later at Clark University. During the summers, as an instructor at the University of Indiana Biological Station at Winona Lake, I was associated with Eigenmann, Caldwell, Needham, Hodge, and a number of young biologists. It was from my associations with these men that I got my ideas as to the materials and methods of biological education. I was taught that the *materials* should be plants and animals, and that the *method* should be that of the laboratory and the field. Textbooks and teachers were to be only helps and guides. I have never strayed far from this early teaching.

The aim and purpose of biology teaching was not always so clear. Whether it was to teach a useful body of knowledge or to create a habit of mind was an open question. Huxley and Jordan had taught that it should serve both purposes, but a great many biologists of that period were little concerned with any application of the knowledge taught. Hodge was an exception. He defined nature study as "learning those things about nature most worth knowing to the end of doing those things that make life most worth living." He believed that the plants and animals studied should be those that had some intimate relationship to the well-being of mankind, that in the selection of such plants and animals interest could be added to the other desirable attitudes of mind developed.

Since this period there has been developed a vast mass of biological knowledge directly related to human welfare and well-being. Most of our knowledge of genetics, endocrinology, phytopathology, bacteriology, economic entomology, limnology, and nutrition with their important individual and social significance has been developed in the past thirty years. During the same period

agriculture, home economics, physical and health education, and psychology have gained a large place in the curricula of our schools. Because of the individual and social significance of these subjects, and because they took over much of the biology that pertained to human welfare, these subjects found a large place in the education of our youth and fundamental biology was in many places almost crowded out of our elementary and secondary schools. The indifference of many of those engaged in the field of biology and the education of teachers of biology toward any application of biological knowledge to the problems of mankind had made it easy for these subjects to supplant biology in the high school curricula. However there were some biologists who were not indifferent, but were disturbed at what was going on.

I remember the attempts of the Kansas biologists to reinstate biology in the schools. The biology roundtable of the State Teachers Association brought Coulter, Besse, Needham, and Bigelow in successive years to Kansas to tell us what to teach in biology in order to attract a larger number of students into the biology classes. We were advised by some to go ahead teaching botany and zoology. Needham and Bigelow especially advised us to teach a biology that had some special application to the problems of agriculture, home economics, health education, and other phases of man's well-being. They pointed out that the physical science classes in the high school were filled because the students in these classes found an immediate application for their knowledge.

In colleges and universities throughout the country courses in agricultural zoology, agricultural botany, agricultural bacteriology, household biology, household bacteriology, etc., began to appear in an attempt to teach some biology with an individual and social significance. The titles of high school texts were changed from general biology, botany, or zoology to such titles as "Civic Biology," "Human Biology," "Applied Biology," "Biology of the Home and the Farm" in order to make them more attractive. One publisher simply tore the backs off a series of botany and zoology texts and brought them out under a designated title without a word of change in the text with the hope that they would find a wider sale.

Probably there was another reason for the lack of popularity of biology in the high school curricula. Too often the laboratories were unsightly and ill smelling, and the teachers were untactful in presenting many of the vital processes and therefore offended not only the students but their parents. Then there were those young enthusiastic teachers who offended many in their tactless presentation of the laws of evolution, heredity, and reproduction. The physical sciences taught in our high schools had no such intimate relations to life and were acceptable, while much of the biology was related directly to the intimate processes of living and if not tactfully presented gave offense. The curricula of the high school being also largely classical, the educational authorities in charge often had something of the same attitude toward biology that they have today toward industrial and vocational education. The English and Latin teachers were not convinced that the biology teacher was a cultivated and refined individual.

In many places through the country there have always been disciples of Huxley and Jordan, biologists who believed that the fundamentals of botany and zoology should form the basis of biological education. These biologists also believed that in teaching these fundamen-

tals of botany and zoology a body of knowledge directly applicable to the welfare of the human race could be presented, that the laws of evolution and heredity and reproduction could be made a part of the courses in biology without in any way offending the students, and that the attempt to attract students to biology by giving such courses as agricultural botany, zoology, and bacterioloy, or household biology, or any other designated course was futile. They also believed that the tendency to highly departmentalize work for the student who was going to teach biology was a mistake, that those highly specialized in botany, zoology, physiology, or bacteriology, in the nature of things, could not be the best teacher of the fundamentals of all the biological sciences. They also realized that if the high school biology teacher was to present the biological knowledge most intimately related to man's well-being, he must fill his courses with the essentials of the developing sciences of bacteriology, endocrinology, genetics, entomology, and plant pathology.

Today it is encouraging to this group of men that The Union of Biological Societies of the American Association for the Advancement of Science has turned its attention to promoting a wider and better biology teaching in our elementary and high schools. It is also of interest that at the graduate level several universities are offering graduate work with a major in biology as preparation for secondary biology teaching. Probably the most significant move looking to better and more universal teaching of biology is the organization of the National Association of Biology Teachers. It should enlist the support of all secondary, college, and university teachers of any biological subject who are interested in having the knowledge in their fields find wider application in the lives of men and women.

Opaque Projection in Biology

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Division of Schools, The Panama Canal, Canal Zone

Opaque projection is ordinarily still projection, and still projection remains one of our most effective means of instruction. Moreover, as will be noted later, a considerable amount of motion can be shown with an opaque projection instrument. Such a machine directs the attention of all observers to the same thing at the same time and for as long an interval as is necessary for careful study and discussion. Material can be repeated as needed. The whole process is very flexible. In the paragraphs which follow the writer hopes to point out some of the wide variety of uses to which this instrument can be put.

Opaque Objects

The amount of opaque material which can be projected advantageously in the biology classroom is almost unlimited, and the cost is negligible. Illustrations from books, magazines, and catalogues are easily screened. Charts, hand-drawn sketches, and maps can often be used effectively. Typewritten or handwritten assignments and announcements can be made by the use of this machine. Postcards and photographs—photographs

taken by the instructor or students on a summer's trip, for example—can be shared by all at the same time. Excellent permanent collections of opaque illustrative materials can be made by cutting up old textbooks and catalogues and mounting the cuttings on cardboard backs of a uniform size which will handle easily in the projector. Riker specimen mounts slipped into the machine will show insects, life cycles, leaves, etc. Newspaper reports can be used while information is opportune. The story and pictures of an ascent into the stratosphere, another of Beebe's ocean descents, forest and wildlife destruction by a tornado, news of an epidemic or any other pertinent scientific news can be flashed upon the classroom screen on the very day the report appears in print. This function alone would make the opaque projector a very valuable piece of equipment.

For the best results the room should be as dark as possible for opaque projection—considerably darker, for instance, than for satisfactory lantern slide work. The reason for this is the fact that the screen receives only that light which is reflected from the opaque object being projected. As a result, the image is not as bright as in the case of the transparent glass slide where the light is transmitted.

"Daylight" Projection

However, "daylight" projection is satisfactory in rooms which admit a considerable amount of light. In this case a short focus projector is used in connection with a translucent screen which is placed between the machine and the observers. The size of the picture is considerably smaller than that attainable with lantern slides in a dark room, but in small class groups this use is quite adequate for ordinary needs. Here in the Canal Zone, where tropical temperatures and high humidity make a tightly closed, dark room highly undesirable, "daylight" projection is used most of the time.

Chart Making

Good charts are indispensable in successful biology work, but at prices ranging from two to ten or more dollars each the cost for an adequate collection of this graphic material becomes prohibitive for the average school. Charts can be drawn by hand on large sheets of cardboard or chart cloth. However, this is generally a tedious process, and unless the individual has some talents along these lines the results may not be entirely satisfactory. We have found the combination opaque and glass slide projector to be of great value in making classroom charts. Lantern slides or pictures, diagrams, tables, and similar opaque materials from various sources are projected against large pieces of good grade cardboard or chart cloth. The desired size of the chart is obtained by regulating the distance between the projector and the image. Next the image is outlined lightly in hard pencil. Later these lines are inked with a broad-point pen and

Courtesy Spencer Lens Co.
The combination projector is a versatile instrument for developing interest.

permanent black or colored ink and the chart labeled. A whole library of graphic material can be built up in this way, and the cost per chart is only a very few cents for cardboard or chart cloth plus an hour's work. Careful students can learn the technique in a very few minutes and will enjoy doing this kind of work because it will soon come to the attention of the whole group in classroom usage. In many cases we have found it desirable to label the charts with letters or numbers rather than names. Then they may be useful for both teaching and testing purposes.

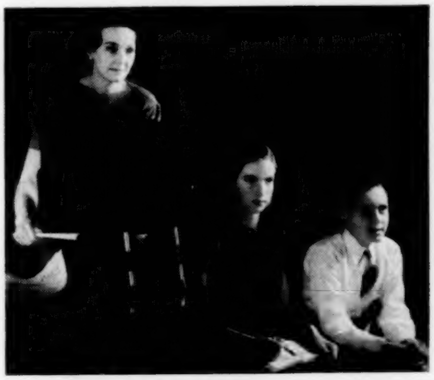
Frog Heart Beat Demonstration

The effect of temperature on the rapidity of heart beat in cold-blooded animals can be demonstrated in a striking manner with the opaque projector. For this purpose an average- to smaller-than-average-sized common leopard frog, *Rana pipiens*, is excellent. First, pith the brain and spinal cord or thoroughly anesthetize the animal. Carefully remove the body wall which covers the body cavity and expose the viscera. Be sure the heart is well exposed and functioning normally. Now place the specimen back down in a white-bottom, shallow pan or pin it out in a wax-bottom dissecting tray through white paper. Finally, surround the heart with snow or finely crushed ice, leaving an opening just large enough to observe the heart action. After the heart has slowed down to its minimal speed, place the whole dissecting tray under the projector and focus. Count the rate of heart beat for half a minute as soon as the focus is sharp. The heat from the projection lamp will melt the snow or ice rather rapidly and warm the resulting water. As the temperature mounts the rate of heart beat increases. After three to five minutes or so the rapidity should be noted again. An increase of fifty, seventy-five, or even one hundred or more beats per minute will ordinarily be noted. This makes an excellent demonstration and one which is relatively easy to execute.

Miscellaneous Uses

Earthworms, lubber grasshoppers, and other small animals can be pinned out and the whole mount projected for the study of gross anatomy. Twigs covered with scale insects, wood destroyed by termites or borers, leaves bearing galls, and similar materials are readily screened. Likewise, fossils can, in many instances, be studied by the whole class at one time through the use of this machine.

Occasionally it is desirable to show some development in a chemical test tube, for example the growth of crystals or Fehling's reaction. With a combination opaque and lantern slide projector this is a relatively easy matter. Simply remove the slide carrier, insert the test tube into the light path, and focus. The entire class will be able to see what is going on at one time.



Courtesy Bausch and Lomb Optical Co.

The amount of opaque material which can be projected advantageously in the biology classroom is almost unlimited, and the cost is negligible.

COMBINATION VS. SEPARATE OPAQUE PROJECTORS

As long as standard makes of instruments are used there is little or no difference in the quality of projection between separate opaque projectors and combination opaque and lantern slide machines. Both are entirely satisfactory for ordinary purposes. However, the separate projector is good for one use only, namely opaque projection. The combination machine costs more than the separate instrument, but the price is considerably less than the combined prices of the opaque projector and projection lantern purchased separately. In the opinion of the writer the combination machine is well worth the difference in price over the separate instrument. In this combination machine all the classroom equipment necessary for ordinary still projection is combined into a single compact unit. Lantern slides properly screened probably make the nearest approach to perfection in visual aids to instruction. Simple inexpensive attachments convert combination machines into satisfactory film slide projectors or microprojectors, instruments of unquestioned value in biological work. The combination unit for opaque materials and lantern slides, together with its various attachments, has so many advantages that it must be considered as perhaps the most versatile projection instrument available for use in the biology classroom.

Arousing Interest in Senior High School Biology

JOHN E. SHOOP
New Rochelle Senior High School, New Rochelle, New York

The element of interest is most easily obtained in school work when the teacher can bring to the students subject matter that they can successfully master. It should be that type of subject matter which is going to be of immediate or of assured future value to them. That element of interest is most easily obtained when the teacher is willing to sacrifice time and energy to adapt the subject matter to the varying degrees of ability and capacity that make up the personnel of the class. That element of interest is gained when teachers begin to measure achievement not in terms of percentage or grades, but in terms of educational growth.

Interest can be aroused by offering as many allied educational experiences as the field can embrace. In this way each student becomes conscious of some one particular phase of the work, which, due to close correlation, creates interest in other phases and leads the student on to new fields of endeavor. Educational growth consists not merely in the acquisition of factual knowledge, but also in the application of the principles as they are learned. These principles, having once become part of the actual experience of the individual, have a definite place in his educational background and tend to modify his reactions.

In the New Rochelle Senior High

School the biology course is open to students in the tenth, eleventh, and twelfth grades. We recognize the different levels of ability by offering three separate courses in biology: Advanced Biology on two levels, and Elementary or Human Biology. Placement of students in these courses is dependent upon their ability, interest, and future educational plans. Near the end of the ninth grade, achievement tests are given in various subjects, for placement purposes in the tenth grade. Placement of students in the biology courses depends upon results of these tests, I.Q. ratings, and teachers' estimates, as well as educational plans. If a student placed in one of the courses shows evidence at any time of being incorrectly placed, he is changed to the proper course.

In the second week of school each student is given a Cooperative Test in Biology to show how much foundation he has in the subject matter before taking the course. These results are tabulated, explained, and posted, so that each student knows what percentile rating he has attained. In February and again in June similar tests are given, tabulated, and posted, to show the student what relative growth he has made in the subject.

A reference outline covering the entire course is given to the student instead of a textbook. The outline lists references to forty-seven different basic textbooks which are placed in the library for the use of the students. No student is required to do any of this work unless he wishes, because each and every assignment in the reference book is carefully gone over in class lectures to reinforce what the students have read. Although only three hundred students can be accommodated in this elective course, 12,732 biology books were borrowed from the school library during the school year 1937–38; 8,475 in 1938–39; and more than 7,000 thus far in the present school year.

The drop in the number of books borrowed in 1938–39 is explained by the fact that during that year we provided one library period per week for each student. Through the cooperation of the administration and the Librarian we have been able to build up the Biology Reference Library until it now comprises 683 volumes of 240 different titles. Also, there are magazines of a biological nature; such as "The Quarterly Review of Biology," "School Science and Mathematics," "Natural History," etc.

As soon as the pupils in the various classes are acquainted with each other, a representative is elected from each class to form what is known as the Biology Council. The purpose of this Council is to meet with the teachers of the Biology Department to decide the policies to be pursued throughout the year. Such questions as homework, reports, supplementary materials, grievances, poor teacher explanations, suggestions how to better the course, and subject matter content are considered in Council meetings. If any student feels he has a complaint or a suggestion to make, he tells the class representative who brings it to the Council for consideration.

The members of the Council also act as contact agents for the Biology Club. Membership in this club is not confined to biology students. It now has a membership of 168. No dues are charged; any costs are defrayed by the General Organization of the school. The officers are President, Vice President and Secretary-Treasurer, who have administrative authority under the supervision of the teacher in charge. The club has biweekly meetings throughout the school year. The program includes speakers

on various biological subjects. These speakers are generally eminent men in their particular field of interest. We find that they are usually willing to come without cost to a gathering of this kind.

Following are some of the topics that have been presented at club meetings: "Specialization in Reptiles" illustrated with thirty live snakes; "Nursing, its Advantages and Disadvantages"; "General Patterns of Problem Behavior"; "Where do we stand on Tuberculosis"; "Taking your Borings" (a talk on teeth); "Cancer" with an exhibit on display in the school; "The Evils of Marijuana"; "Bees." Other activities of the Club include field trips to various hospitals in New Rochelle and neighboring towns, to Children's Village (a corrective institution for boys), to Museums, to New York Medical Center, and to Boyce Institute of Plant Research. In the spring and fall we take morning hikes, leaving the school about 5:30 and returning in time to have breakfast, which is prepared by the lunchroom staff in our own school cafeteria. In addition to this we have several parties during the year, which create better social feeling between the pupils and between the pupils and teachers.

When possible the class lectures are illustrated by motion pictures, slides, charts, models and actual specimens, both preserved and alive. We are fortunate in having a room which is equipped with projection facilities, and also a connecting storage room where special display materials are available for instant use.

Various topics based upon the work covered throughout the year are suggested for term papers. The work on each term paper is done by a group of students interested in that particular topic. The best term papers are then selected, mimeographed, and made into a booklet, a copy of which is given to the students contributing, and one copy is placed in the school and city libraries for future reference.

Closely correlated with the lecture work are a number of important laboratory experiments, about 60 in all. These experiments are performed individually by each student and a record of them is kept in a laboratory manual. The laboratory manual was especially prepared by the department for use in conjunction with the lecture material. The laboratory is open four afternoons a week after school for students wishing to do extra work not connected with the regular laboratory routine.

In the latter part of May a questionnaire is given to each student, which contains criteria for rating the course and the teachers and asks for criticisms and for suggestions on how to improve the course. This has definitely aided us in modifying the course and adapting it to student needs and interests.

At the end of the course several awards are given for outstanding achievement, based not only on mathematical computation of grades, but also on cooperation, leadership, and assumption of responsibility.

These activities have proved very successful in New Rochelle in arousing interest in biology to a point of enthusiasm. When the course was started seven years ago its membership numbered thirteen. Now we have a total enrollment of 279. Other factors which we consider would be very useful in arousing interest are: A Browsing Room for the use of biology students only; Additional courses in the field, such as Bio-Chemistry—for students specializing to be nurses, dietitians, laboratory technicians, medical and dental assistants, etc.; Consumers' Biology—a general information course for students not preparing for college;

Biological Appreciation—an appreciation of biological contributions, including current events, for avocational background.

By offering these new and varied courses we feel that the period of interest of biology students could be prolonged, and that many other students would become interested.

THE BIOLOGY EXCHANGE IDEA

The establishment of a biology exchange service is one of the most interesting and educational activities that a biology club can undertake. The exchange idea allows boys and girls an outlet for a natural inclination to "swap" articles of all kinds.

One of the first projects to start after a club has decided to establish an exchange is to collect large quantities of local fauna and flora. The immediate project is to collect accurately labeled specimens in large numbers. The thought uppermost in collecting local material should be accuracy of data, specimen interest and conservation trends.

The data collected with each specimen should include exact location in terms of miles from a well established landmark. Jones farm is sufficient for local interest but "Jones farm" on the specimen record card should read three miles east and 1 mile south of Cherryvale school, Idabel, McCurtain County. These are termed "spot" locations and the range of an animal is often accurately mapped from such spot locations.

Specimen interest in its broadest sense should dominate field collecting. The animals or plants that do not interest one person or club might be the exact group wanted by another club. Interest in a particular group can usually be built up by systematic collecting designed to show habitat relationships, genetic variations or other peculiarities. Rarity of a specimen in the local area can usually be overcome by specific exchange requests. The occurrence of a plant or animal within an area as determined by a check list does not guarantee that the local club will find that specimen.

Collecting and Preserving

The club, in preparing for a field collecting trip, sees that all supplies are ready and the carriers available. The type of equipment carried will depend upon the main objective of the trip.

In preparing data sheets to be recorded on the specimen card or index card in the museum, the club or trip manager sees to it that each collecting stop is a numbered station in the notes. After compiling the information for the card file the station number is all that is necessary to properly locate a given specimen. Field notes and remarks often prove very valuable in identification.

Special methods and techniques are employed for many animal groups. Most of the animals taken in the field can be preserved in formalin of five to eight per cent strength. Ethyl alcohol may be used for the same purpose. Opinion differs as to the best way of killing the animal to preserve it. It may be dropped directly into the formalin or chloroformed, or drowned. The latter technique has many advantages for reptiles and amphibians.

A specimen drowned in an air tight container has the advantage of being limp and flexible and easily handled. Amphibians and reptiles are injected or slits cut in the abdomen to allow the preserving fluid to penetrate the body cavities. Injection has the advantage of swelling the animal to normal size and giving a more natural appearance. The animal can then be pinned in any position and preserving fluid poured over it.

After several hours the animal is hard or set and can be moved without altering the shape in any way. Sometimes it is desirable to preserve a snake with its mouth open. This technique is easily performed by stuffing paper or cotton in the mouth until the desired shape is reached. Leave the packing in the mouth until the animal is "set" or hardened by the preserving fluid. The packing can then be removed and the mouth remains open showing teeth and tongue.

Making Exchange Contacts

The club makes exchange contacts by writing letters directly to another club or by having some journal print a note concerning the desirability of exchange. The latter method is productive of the best results. The cooperation of the editors of the following journals is helpful, American Biology Teacher; *Turtox News*; *Nature Magazine* and *National Nature News*. Affiliation with Junior Academies of science in the state or membership in a national organization is also helpful.

Shipping

The exchange club will find it helpful to notify the receiving club well in advance when to expect their shipment. The shipment of course may go by express, freight or parcel post, depending upon the size and weight of the parcels. All shipments should be prepaid to the exchange club. In packing, glass jars should be well protected by paper or packing of some sort. The individual jars of the shipment will of necessity carry many different specimens. Each specimen should be given a tag that is numbered or named. The exact name corresponding to the number is forwarded by letter. Several specimens of each species should be included in the shipment. However, only one specimen need be tagged. The receiving club should be told that their shipment is packed in formalin of five per cent or other grade used.

The shipment of live animals from one state to another should be avoided because of the danger of spreading diseases and parasites from one place to another. Further there are legal complications in such an activity.

Cataloguing and Indexing

The exchange service of a club may be aided greatly by the "office" that it keeps. The club needs a means of indexing its own museum materials and having the information available at all times. In addition, the letters from incoming contacts must be answered, their needs noted, and shipment date determined from stock on hand.

An efficient way of doing this is to use an alphabetical index book and write the name of the club or individual under the alphabetical listing. The letter itself is filed in a vertical file folder numbered consecutively, according to their receiving date. Then at any instant the correspondence concerning a shipment can be located, a contact verified or needs determined.

Value of an Exchange Service

The immediate value of an exchange service to a club is apparent in the more alert and enthusiastic spirit of the club. All boys and girls in the club have an equal share in the activities of the club. The personalized contact with other boys and girls is educational and inspirational. There is a wholesome pleasure in helping in a scientific way other clubs to limit or extend the range of a species of plant or animal.

The field trips necessary to such a

project are an ideal place to teach techniques, conservation and biological principles.

Such a procedure followed over a period of years will build a systematic teaching museum more valuable to the students than purchased materials. There is always the personal association, geographical locations, people and places involved in a large collection.

WILLIS W. COLLINS,
Idabel Junior-Senior High School, Idabel, Oklahoma

RIP VAN WINKLE SCIENCE

Among recent articles, one which arouses the most intense interest and at the same time the most mingled feelings in this reader, is by Mr. Raymond F. Forbes, and appears in the May 1937 issue of *School Science and Mathematics.*

Mr. Forbes states that the school subject most worth while to him is the one which taught him how to think. This enabled him to solve many sorts of problems in his business. That course is the most valuable for anybody who can master it, as the ability to solve personal, business, or professional problems is the great thing. Every life is full of problems, if of little else.

Such a testimonial is most gratifying to a school teacher. In spite of the everlasting and widespread criticism of formal schooling, namely, that it crams facts, facts, facts, and more facts, and gives no training in the all-important ability to think, it seems that at least one pupil got the worth while thing out of the system.

Mr. Forbes describes the method of thinking, the steps taken in solving problems, the application to life. In his own words he describes in considerable detail: the definition of the problem, the search for indication, the formulation of alternatives, the adoption of a hypothesis, the deduction, the proof, and the application;—clearly he describes the scientific method.

This also is very gratifying to a teacher of natural science, whose subject matter field predisposes him to agree with the proposition that the main if not the sole goal of education is or should be, the inculcation of "that attitude of mind, that habit of thought, which we call scientific."[1]

And now comes the jolt. The course which gives Mr. Forbes these inestimable values is not a course in science! It is the old cut-and-dried college entrance course in *plane geometry* with its carefully selected and predigested battery of artificial "originals." A comparative study of science and geometry texts shows that Mr. Forbes' experience indicates a general and not an exceptional condition. Plane geometry texts give practice in scientific method; science texts do not! A little further study discloses a text for English that portrays the scientific method far better than any science text of which I am aware![2]

I suppose that others must attempt to teach scientific method since science teachers will not do so. But what a condition of affairs! Are science teachers natural-born Rip Van Winkles, or do laboratory smells deaden "the higher mental processes"?[3]

PHILIP B. SHARPE,
Greenwich High School, Greenwich, N. Y.

[1] *How We Think*, by John Dewey, p. iii, Heath, 1910.

[2] *Using English*, Book Two, by L. B. Cook, Part One, Harcourt, Brace and Co., 1935.

[3] *Education as Cultivation of the Higher Mental Processes*, by Charles H. Judd, Macmillan, 1936.

PRESIDENT'S MESSAGE

The National Association of Biology Teachers came into being only because it was needed. So enthusiastic has been its reception that I venture the opinion that had it not been started when it was (July 1, 1938), some other organization with similar objectives would have sprung up by now. The movement to organize the teachers of biology in the high schools was overdue.

This ripeness of time was doubtless one of the reasons for the rapid growth of the movement—around two thousand members in two years. But there were other reasons, namely, the low cost of membership; a lively magazine with a practical slant; a sensible, workable policy as written into the constitution; and, as I have discovered, a group of officers with an eye single to the needs of those actually engaged in the teaching of the life sciences to our young people.

The first year was given over largely to building membership, since we could not hope to turn out a monthly magazine for one dollar a year without a large subscription list. But in addition to getting organized, starting a magazine and putting on a drive for members, our first officers found time to seek and obtain affiliation with such national organizations as The Union of American Biological Societies and The American Association for the Advancement of Science. At the same time a working relationship was worked out with existing local biology groups and several of them immediately became our affiliates.

In the second year certain readjustments in organization were attended to, local affiliation work was extended, representation on the National Science Committee was obtained, a permanent editor was secured, and a renewed effort made to obtain additional members. In addition, some exploratory work was done in the field of extending aids to teachers in service.

Now we enter upon our third year and it is altogether fitting that we pause again to inquire our direction. We must continue to build up membership, not as an end in itself but because we need sufficient numbers to ensure a thirty-two page journal every issue. You have doubtless noticed that occasionally during recent months the journal has dropped to twenty-four pages. You should know that whenever this happened it was because there were not sufficient funds on hand at the moment and we were determined to live within our income. From the beginning, articles of considerable merit have appeared in every number, and the Journal is fast making a name for itself. As a result a steady flow of creditable manuscripts is coming in, so that in the future there should be plenty of good material on hand at all times. To put them into print, however, we must have enough members to assure a thirty-two page magazine every month. There must still be many biology teachers unaware of the existence of the N. A. B. T. We want them to have the opportunity to belong, but we must depend upon our present members to spread the word around. I sincerely hope that each reader will consider himself or herself a committee of one to secure new members during the present year.

In the second place as our association grows greater in numbers and hence more secure financially it can become of more and more assistance to affiliated groups and to individual biology teachers. The direction such assistance shall take will depend upon the circumstances

at the moment, but your officers are looking into various possibilities and would welcome suggestions from you.

These are all desirable objectives, to be sure, but it is questionable if they alone are sufficient justification for the existence of an association that chooses to term itself "National." The life sciences have so much to contribute to human welfare that we dare not coast along, complacently defending biology as a school science and knowing all along that it is losing ground. Paraphrasing the Bard of Avon, the fault may not reside wholly in the "Powers that be," but in ourselves. He among us would be audacious indeed who would aver that we as biology teachers have given or are giving to the future citizens of this nation the very best that biology has to offer. The time may be at hand when it would be the part of wisdom to cease rationalizing, to shed complacency, and to assume a more positive attitude. Maybe it will be necessary to alter our entire approach to the teaching of our science. Something of the sort would seem to be indicated by certain of the articles that have appeared in the Journal as, for example, the leading article in the February, 1940, number.

What I should like to know is to what extent such an attitude is abroad in the land, and to what extent a radical departure from the traditional is justified on the basis of expediency, educational philosophy and the needs of young people. As indicated above, your association is already cooperating with a National Science Committee that has been deliberating on such matters for two years. Should we wait for the report of findings of this committee or should we anticipate this report and begin to make our own adjustments right now?

The presidency of a National Association of Biology Teachers at this time is not something to be undertaken lightly. Leadership is not doing something for the mere sake of doing it. It must be borne in mind that the 1940–41 officers wish to represent you.

George W. Jeffers

WE ENTER A THIRD YEAR

With this issue The American Biology Teacher begins its third year of successful publication. As a result of the generous support of many persons—contributors of manuscripts, advertisers, subscribers, officers of the association, and members of the editorial and advisory staff—the most difficult period in the life of a new journal has been safely passed. We look to the future with confidence, soliciting the continued cooperation of all those who in the past have found our pages of value. Our aim is to make the magazine still more useful to teachers, and through them to improve the quality of the biology taught to our students. In this we shall all be making our greatest contribution to the welfare of the nation.

There are at least two ways in which you can help to make your magazine still more useful: first, by advertising it among teachers who are not members of the association, and who may even never have heard of its existence; and second, by sending in your own written contribution of experience or ideas. Short articles and notes, including news items, are especially welcome. If you have a question in the field of biology we shall attempt to obtain and publish an answer from an expert. All letters of general interest will, so far as space permits, be published promptly. May we hear from you?

WE ARE QUOTED

"Among the several fine publications which carry suggestions valuable to teachers interested in using conservation material in their classes, we consider THE AMERICAN BIOLOGY TEACHER, published by the National Association of Biology Teachers, one of the best." This is the lead-off sentence of a fine tribute appearing in the April, 1940, number of *Virginia Wildlife*, the official bulletin of the Virginia Wildlife Federation, published monthly at Blacksburg, Virginia. The article ends by advising those interested to send a dollar to our secretary-treasurer, Mr. P. K. Houdek. In this case we can return the compliment for we can say that the *Virginia Wildlife* is probably the best state organ devoted to Conservation Education that has come to our attention. Incidently, this fine monthly bulletin costs only twenty-five cents a year.

Virginia Wildlife follows this up in the May number by quoting from the article "A Dependable Remedy for the Poison Ivy Group" by James B. McNair, which appeared in THE AMERICAN BIOLOGY TEACHER for January, 1940.

That our *Exchange Items* are appreciated is shown by the fact that the entire Exchange note of W. W. Collins, in the January number is quoted in full in the May 13th number of *National Nature News*, published weekly at Washington, D. C. The subscription rates for this magazine are: 50 cents per person each semester, for clubs of five or more; $1.50 per school year, or two years for two dollars.

G. W. J.

EXPERIMENTS IN HEREDITY

Teachers of biology are reminded of the generous offer made by the Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, New York, proposing to furnish without charge a variety of mutant types of the vinegar-fly, *Drosophila melanogaster*, for starting stock cultures. Detailed instructions concerning the care and handling of the flies will be furnished at the time the flies are sent, as will also the essential biological data requisite for successful completion of the experiments. The full announcement of this offer was published in the May issue of THE AMERICAN BIOLOGY TEACHER. The purpose of this service is the encouragement of a wider use of laboratory experiments in the study of heredity in classes of biology and in biology clubs. Correspondence should be sent to the above address.

MEMBERSHIP RENEWALS

A Renewal blank is enclosed with this issue. By sending your renewal without further request you will make a contribution to the funds of your association available for promotion.

Already a considerable number of our members have sent in their renewals, some for several years ahead. If you have already renewed you may use the enclosed blank to enroll a new member.

Members who are also members of a local affiliated biology teachers association may use the renewal blank to remit their dues through their local officers.

Your suggestions to the Editor or officers may be written on the back of your renewal blank.

Eggshell Caps—A Method of Rearing Chick Embryos Visible Throughout Incubation

JOHN W. PRICE and ERNEST V. FOWLER
The Ohio State University

To watch a living chick embryo develop is always interesting. To do this, we are usually content to follow the method of opening a number of eggs which have been incubated previously for the desired number of days, and to regard the exposed embryos as constituting a continuous series (see Miller and Blaydes).[1] However, many teachers of Biology have wished for a simple method of observing the same embryo day after day throughout its incubation. Such a method would impress the student with the continuous nature of development, which is a fundamental concept. It would focus attention upon the new features that develop day by day, thus impressing the student more strongly. Furthermore, it would reduce the number of eggs needed to demonstrate the entire course of their development and hatching.

The authors[2] have reported recently the successful incubation of chick embryos with the so-called eggshell cap method. It is so simple and easily followed that it should serve as a workable and interesting laboratory project in high school biology classes. In addition to the advantages listed above, it presents the growing chick still within its shell so that the normal interrelations between the organism and its environment are maintained.

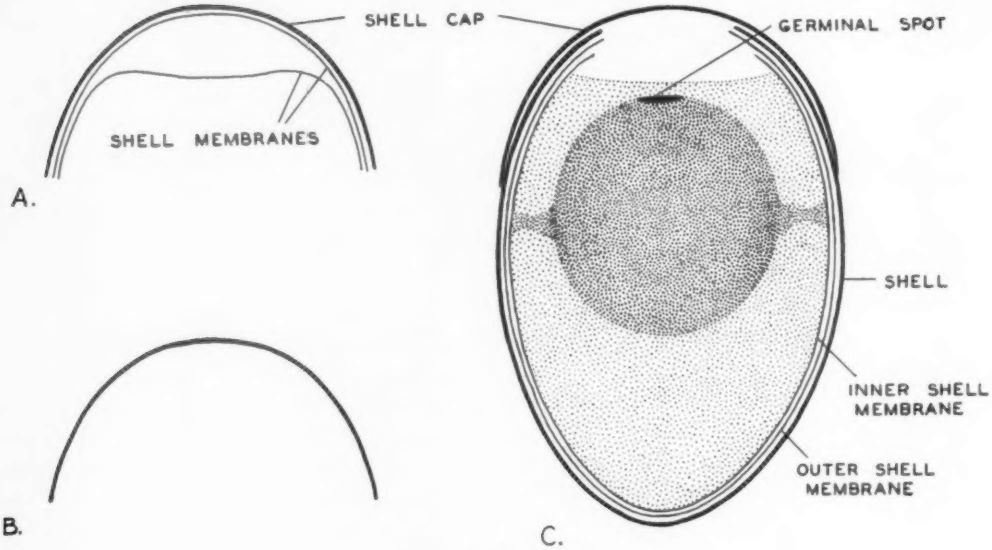
This method involves the removal of the eggshell and both eggshell membranes, to expose the embryo and its extra-embryonic membranes directly beneath. The embryo may thus be observed directly and is subject to manual manipulation.

The method of preparation is simple: First, an eggshell cap is prepared by breaking an egg at the small end, emptying the contents and, with scissors, cutting the empty shell around its middle. The result is approximately a half eggshell with a cross-section similar to Fig. A. It is then dried and both shell membranes are removed, as in Fig. B. The eggshell cap taken from the large end of the egg consists then of the shell only. It is sterilized with alcohol, dried, and kept in a covered container until used.

Eggs to be incubated are opened prior to incubation. This point seems to be essential, to avoid injury to extra-embryonic membranes and blood vessels which is so likely to occur once they are formed. Holding the egg vertically, with the large end uppermost near a bright lamp, a light area marks the limits of the air cell in that region. After cleaning the eggshell with cotton moistened with alcohol, the outline of the air cell is marked with pencil. With tweezers a small opening is made above the air cell,

[1] Miller, D. F., and G. W. Blaydes, *Methods and Materials for Teaching Biological Sciences*. N. Y.: McGraw-Hill Book Co., 1938, pages 402–403.

[2] Price, J. W., and E. V. Fowler. *Science*, 91: 271, 1940.



Figs. A, B, and C.

and by careful chipping, pieces of shell and membrane are removed to make a circular opening somewhat smaller in diameter than the air cell beneath. With sterile tweezers the inner shell membrane is next removed to the same extent, leaving the albumen exposed (see Fig. C). The previously prepared shell cap is now placed over the opening and the egg is ready for incubation. The shell cap is not sealed in any way.

After several days of incubation the level of albumen within has dropped and permits the further removal of shell. Care must be taken to avoid injuring the allantois. With a relatively large opening, later stages of development are clearly visible over the entire upper surface.

In the incubator such eggs must be held vertically. Holes may be made in strips of coarse screening to hold the eggs in a standard incubator tray. If the egg is permitted to roll over on its side, albumen will be lost. Held vertically, apparently no turning of the egg is necessary. Difficulty of hatching may be avoided by sprinkling the 18-day egg with water.

The incidence of infection of embryos has been extremely low, considering the fact that the shell cap is simply laid over the eggshell opening and may be removed daily for observation of the embryo. The overlapping margin of the eggshell and its cap is apparently an effective barrier to bacteria. The porous shell of the cap apparently permits adequate gaseous exchange between the living embryo and the exterior, yet prevents excessive desiccation.

In the absence of a commercial incubator, a satisfactory substitute may be made by using a glass-topped wooden box, modified somewhat from the diagram suggested by Miller and Blaydes,[1] p. 402, fig. 141. An ordinary store box of wood about 12″ × 12″ × 24″ and lined with corrugated paper may be covered with two panes of glass which come together across the center above. Within, a lamp bulb is attached near the bottom of the box. A thermometer and a pan of water are placed within the box. The effective temperature near the eggs should be made to remain constant at approximately 101° F. and can be ad-

justed by increasing or decreasing the wattage of the bulb, changing its position with respect to the eggs, or by drawing apart the top panes of glass to allow greater circulation of air. To hold the eggs in an upright position, a sheet of ¼" mesh hardware cloth, with 1½" holes cut to receive the eggs, may be placed as a horizontal shelf across the box above its center.

Given favorable conditions of temperature, humidity and circulation of air, fertile eggs should develop successfully and be observable throughout their incubation period when the eggshell caps are used as described above.

HATCHING CHICKENS IN A LABORATORY

The course of study for high school biology in Washington includes these units: All Life Comes from Life, and Improvement in Plant and Animal Life Depends upon Variations and Heredity. Each unit is given approximately two weeks. During the study of these units eggs are hatched in an electric incubator costing less than $10.00, purchased from a local mail order house. The incubator holds at least five dozen eggs.

Eggs are opened every day or so in order that the development of the embryo may be observed. It is best, but not necessary, to plan to use an egg for each class as each group prefers watching its own egg opened.

To open, an egg is placed in a pan of lukewarm water. The surface which rights itself above the water bears the embryo. With scissors, the shell is punctured at the large end, then cut lengthwise around the shell, taking care not to cut deeper than the underlying membrane. The upper portion of the shell is then removed.

The embryo of the opened egg may be kept alive for at least four hours by keeping it in a warm, moistened compartment. This is prepared by placing a small shallow container in warm water and inverting a large glass dish over all as cover. The small container supports the egg, and all is set in the incubator until the next class.

General directions for setting of the eggs and care of the incubator as well as early care of the chicks come with the incubator. However, all eggs should be set at the same time, for the incubator should not be opened from the eighteenth day to the time of hatching; escape of moisture is thus prevented. It is well to have the eighteenth day come on Saturday so that the class will not miss steps in the development of the embryo. Everyone wants to see a pipped egg. By all means, have enough eggs so that some will be sure to hatch. Candling is recommended so that odors from infertile eggs may be eliminated. Light eggs may be tested on the third or fourth day, dark eggs on the sixth or seventh. After the first day until the eighteenth, the eggs should be turned daily to keep the chick from sticking to the shell. After the eighteenth, the embryo is so large that it cannot change position easily in the shell and besides, moisture must be conserved.

Soon after the egg is placed in the incubator, the embryo, which is already in the early stages of germ-layer formation at the time of laying, resumes its growth. On the second day the heart beats, sending blood through a fine network of arteries and veins. By the third day, the gill clefts on the side of the neck reveal the fish-like plan of body. Limb buds, developing into miniature wings and legs, show well by the fifth day.

Feathers appear on the eighth day. Two weeks are necessary for formation

of the hard beak and claws. Twenty-one days after setting, from the pip, a partial ring is broken around the shell. The chick by pushing its feet against the small end, with its head against the large end, bursts the shell all around and is free.

Our incubator was easily converted into a brooder. A few chicks lived in the class room for two weeks. As long as plenty of food was kept before them and there was sufficient heat, they demanded no attention. For night protection, they were tucked into a well ventilated box and placed under the cover of the hood.

Since the claiming of chicks was apt to become a problem, ownership was arranged before the eggs were set. Even then, the owner did not gain them until he had promised to return them for periodical visits.

The few minutes given every day or so to observation of the developing embryo made no break in the remainder of the lesson period. References were made frequently to the human or mammalian embryos at such a particular stage of development. Many textbooks carry a page of comparative embryos.

Lula A. Miller,
Eastern High School,
Washington, D. C.

AN AIR TIGHT BALANCED AQUARIUM

This technique is a variation of the Spallanzani tube (to disprove spontaneous generation) and originated at a session of the "Laboratory Techniques in Biology" in-service course.

A balanced aquarium is prepared by making a Spallanzani tube and putting in it several snails such as Physa, an alga such as Hydrodictyon or Nitella, and some natural or artificial pond water.[1] The tube is prepared by heating and drawing out a soft glass test tube over a Bunsen flame so that there is a constriction near the center of the tube. After putting in the plants and animals the tube is sealed by applying the Bunsen flame to the constricted portion until it is molten and then pulling and twisting the tube. The top portion of the test tube is discarded.

The writer has prepared such tubes which are maintaining themselves very well. The aquarium water remains very clear in the tube. In some tubes there were definite signs of growth and in one tube where hydrodictyon was introduced, the hydrodictyon reproduced, forming many cylindrical nets or colonies.

Another way of checking on the balance within the aquarium tube is to add some Brom-Thymol Blue to the water before sealing the tube. If decay goes on due to death of plant or animal material, the water will become slightly acid which condition will cause a change in the color of the water from blue to yellow. (Brom-Thymol Blue is yellow in the presence of an acid and blue in the presence of a base. It operates on a pH range of from 6 to 7.6.)

When studying the balanced aquarium in class, enough of these tubes can be made up so that each student can have one for individual study to observe and take notes on. Better still—each student can easily make one himself by following simple mimeographed or verbal directions or watching a demonstration at first by the teacher. The experience of working with glass under a flame and

[1] Artificial pond water can easily be made in the laboratory by using the following formula:

$NaCl$, 1.20 g.; KCl, 0.30 g.; $CaCl_2$, 0.04 g.; $NaH \cdot CO_3$, 0.02 g.

Phosphate buffer, with pH of 6.9–7.0: 50 c.c.

Distilled water to 1000 c.c.

This is a stock solution. For use, dilute this by adding 900 cc. of distilled water to 100 cc. of the solution.

making the aquarium is a pleasureable as well as an instructive one for the student.

Louis Haber,
Seward Park High School,
New York, N. Y.

Biological Briefs

RUTH SHERMAN

McKinney, H. H. *Vernalization and the Growth-Phase Concept.* The Botanical Review 6: 25–47. January, 1940.

Considerable recent research has shown that certain winter annuals and biennials can be induced to hasten their period of sexual maturity by treating the seed or bulb in the early stages of germination. This is known as vernalization. The most successful method to date has been that of soaking seeds or bulbs in water so as to begin germination, and then, under suitable conditions of moisture, to maintain them at temperatures near freezing for from 5 to 60 days. This method appears to have commercial value in hastening the blooming periods of daffodils, iris, and Easter liles, and may be profitably applied in the future to cereal and forage crops.

Vaughan, Warren T. *Why We Eat What We Eat.* Scientific Monthly 50: 148–154. February, 1940.

Our varied diet of today has been developed through the ages, and gathered from world-wide points of origin. Nomads perhaps first discovered many of these, and the development of varieties and methods of cultivating food plants progressed as these nomads became agricultural peoples in prehistoric times. While the crab apple and other small wild forms are indigenous to North America, our large apples came originally from northern Eurasia. Wheat appears to have developed from the wild grasses of Asia Minor or Egypt; it was introduced into China about 3000 B.C. and was known in Egypt in 2440 B.C. Rye, rice, and barley have origins almost as ancient. Corn, apparently native to Mexico, has been cultivated since prehistoric times and is unknown in the wild state. Travel routes have controlled the spread of foods from their points of origin, and the courses of war and trade have frequently been strongly affected by food factors. Such has been the case with coffee, apricots (brought to England in the crusade of 1620), and "Irish" potatoes. The article presents an extensive list of the geographic origins of foodstuffs.

Emerson, Haven. *Eugenics in Relation to Medicine.* Journal of Heredity 30: 553–556. December, 1939.

Physicians may play an important part in furthering the progress of eugenics. They are well-equipped to advise those contemplating marriage or creating a family, and should have a large part in the development and work of the "social control" agencies. The most direct help lies in teaching to each individual and family the facts of human biology. For this purpose, medical schools should broaden their curricula. The doctor should include a family pedigree as a part of his medical records. He should encourage health examinations for prospective mates, and should institute a campaign to minimize exaggerated fears of childbirth. In encouraging voluntary sterilization and birth control measures, physicians may work directly to aid the eugenics movement.

Ley, W. *Animal Fables.* Natural History 45: 84–87; 122–123. February, 1940.

Many strange beliefs concerning animals have a partial basis in misinterpreted truths, while others have been

established as fact by impartial observers. Stories concerning monkeys and rats which form living chains to cross narrow bodies of water are unproven, but certain ants do perform this feat. Bumblebees do not buzz at the mouth of the nest in the early morning to awaken others, but rather to ventilate the dwelling. Scorpions do not sting themselves to death if encircled by live coals, but do thrash about so violently that casual observers might thus interpret their struggles. Ants have been observed to extinguish the flame of a candle placed on their dwelling by bombarding the wick with their abdominal fluid. The many snake fables, concerning hypnotic gaze, milk snakes, hoop snakes, and whip snakes, are of course beyond the realm of fact.

Notes and News

MR. HOMER A. STEPHENS, President-elect of *The National Association of Biology Teachers*, has been granted a fellowship by the University of Wisconsin where he will pursue studies toward his doctorate.

OUR SECRETARY-TREASURER, MR. P. K. HOUDEK, of Robinson, Illinois, spent the summer working for the State Department of Public Health. Much of the time he was driving over the state visiting clubs and other organizations and assisting the various groups in working out programs of health lectures for the coming year.

THE ATLANTA SCIENCE CLUB of Atlanta, Georgia, has been accepted by the Executive Board as an affiliated local society of the *National Association of Biology Teachers*.

We hope to have more news of the activities and program of this new affiliate in an early issue of THE AMERICAN BIOLOGY TEACHER.

THE BIOLOGY SECTION OF THE ILLINOIS HIGH SCHOOL CONFERENCE will meet at Urbana, Illinois, November 1, 1940, under the presidency of Madeline Dague. The following program is announced:

9:00 Book Review: "High Schools and Sex Education."
Glenn V. Ramsey, Peoria High School.

9:30 "How to Make and Use Color Slides in Teaching."
J. B. MacHarg, Eastman Kodak Co., Rochester, New York.

10:00 Address.
Professor G. W. Rosenlof, Teachers College, University of Nebraska, Lincoln, Nebraska.

10:30 "Adventures with Birds." (Lecture and motion pictures.)
Dr. Olin Sewall Pettingill, Jr., Instructor in Zoology, Carleton College, Northfield, Minnesota.

12:15 Luncheon. "Lane Technical High School's New Charles E. Lang Formal Garden as a Biology and School Project"—Illustrated with enlarged photographs, drawings, and blueprints.
M. C. Lichtenwalter, Lane Technical High School, Chicago.

1:30 Business meeting.

2:00 "Vitamins, Their History and Value."
Dr. Frank B. Kirby, Director of Education, Abbott Laboratories, North Chicago, Illinois.

2:30 "Reading and Reference Books for the Biology Library."
Lyle Bamber, Librarian, Biology Library, University of Illinois.

3:00 "Correct Approaches to the Study of Nature."
Rev. George M. Link, Field Naturalist, Pere Marquette State Park, Grafton, Illinois.

THE DELAWARE VALLEY BIOLOGISTS CLUB, organized last spring with the assistance of President Jeffers, gives promise of being a very active and helpful association. The officers elected by this group are as follows:

President: Mr. Clarence E. Feick, South Philadelphia Boys High School, Philadelphia, Pa.

Vice-President: Mr. B. Bartram Cadbury, Friends Select School, Philadelphia, Pa.

Secretary-Treasurer: Miss Janet P. Jamieson, 117 Maple Avenue, Bala-Cynwyd, Pa.

Executive Committee Members: Dr. Robert B. Gordon, State Teachers College, West Chester, Pa.; Mr. Charles E. Mohr, Academy of Natural Sciences, Philadelphia, Pa.; Dr. Edward E. Wildman, Philadelphia, Pa.

Through the cooperation of the Committee of Biological Science Teaching, headed by Dr. Oscar Riddle, and our National Association, the Delaware Valley Biologists Club will undertake to enroll the biology teachers of the area in and around Philadelphia. Any of our members in this area who are not acquainted with this new local association are asked to get in touch with the Secretary.

THE NEW YORK ASSOCIATION OF BIOLOGY TEACHERS presents *Adventures in Biology*. The publication of this handbook of helps for biology teachers has been a project of the New York Association for some time. The booklet will be helpful to any biology teacher. The authors are to be congratulated on its preparation.

The price of the booklet is fifty cents. However, by special action of the executive committee of the New York Association it may be purchased by any member of *The National Association of Biology Teachers* for thirty-five cents, which is the price available to their own members.

Send your remittance with your order to Miss Estella R. Steiner, Corresponding Secretary, New York Association of Biology Teachers, Grover Cleveland High School, Ridgewood, New York, with the notation that you are a member of our National Association.

DR. GEORGE W. JEFFERS, President of *The National Association of Biology Teachers,* has been elected president-elect of the Virginia Academy of Science. He has also been made a director of the American Science Teachers Association.

THE CHICAGO BIOLOGY ROUND TABLE held its first meeting of the school year on Friday evening, September 20, at the Chicago Woman's Club. Mr. Gerald Bench, newly appointed Director of Science and Visual Education for the Chicago Public Schools, formerly head of the biology department of Wells High School, spoke on the work of his department. His talk was illustrated with films. Mrs. Anna Kummer, Waller High School, led a discussion on *Weeds*. An interesting collection of plants classed as weeds was exhibited.

On October 5, the Round Table conducted a field trip to the Morton Arboretum located several miles west of Chicago.

The officers for last year have been reelected for the current year. They are:

Mr. Ildrem P. Daniel, Lake View High School, President.

Miss Thelma Jones, Bowen High School, Vice-President.

Miss Ruby Fremont, Calumet High School, Secretary-Treasurer.

Mr. M. C. Lichtenwalter, Lane Technical High School, Corresponding Secretary.

SCIENCE NEWS LETTER, published by *Science Service*, Washington, D. C., may now be obtained by members of *The National Association of Biology Teachers* at the special rate of $3.00 per year instead of the usual rate of $5.00, as the result of arrangements reported by President Jeffers. It is hoped that a large number of our members will take advantage of this opportunity to save two dollars on a very fine magazine.

SPENCER LENS COMPANY announces

that in order to provide facilities for the production of optical instruments and optical parts required by the National Defense Program it has let a contract for the construction of new buildings which will provide about 130,000 square feet of additional floor space. The new buildings will make use of the latest developments in heating, lighting, plant layout, flexibility for expansion and changes, and working conditions and facilities contributing to the welfare of employees. Orders for machinery and equipment have been placed, and it is planned to have the new unit in operation not later than February 1, 1941. Approximately one million and a quarter dollars will be expended in carrying through the current program.

The National Research Council Committee on Human Heredity has at its disposal certain funds for use in furthering studies in human inheritance. Qualified persons are invited to submit requests for grants where needed to initiate or to continue research in this field. Requests should be sent as soon as possible to any member of the committee, and should include a clear statement of the problem, results already achieved, if any, the approximate time required to finish the problem, the amount of money needed, and a statement as to how the money will be spent if granted.

The committee consists of Halbert L. Dunn, Bureau of the Census, Washington, D. C.; L. C. Dunn, Department of Zoology, Columbia University, New York City; K. S. Lashley, Department of Psychology, Harvard University, Cambridge, Mass.; George L. Streeter, Bureau of Embryology, Carnegie Institution of Washington, Baltimore, Md.; Sewall Wright, Department of Zoology, The University of Chicago, Chicago, Ill.; and Laurence H. Snyder, *chairman*, Department of Zoology, The Ohio State University, Columbus, Ohio.

JOINT MEETING WITH CENTRAL ASSOCIATION OF SCIENCE AND MATHEMATICS TEACHERS

On November 22 and 23, 1940, at the Hollenden Hotel in Cleveland, Ohio, will be held the annual convention of the Central Association of Science and Mathematics Teachers. By the approval of the executive board of *The National Association of Biology Teachers* we are cooperating in this meeting. The Greater Cleveland Biology Society will hold a joint meeting with the Biology section of the Central Association. *The National Association of Biology Teachers* will cooperate in other ways in the promotion of this important meeting for biologists.

The principal speakers on the joint program will be Dr. Visscher of Western Reserve University, and Dr. Williams of the Cleveland Museum of Natural History. This part of the program has been arranged by Mr. Al. G. Grosche, Chairman, and Mr. John C. Mayfield, Secretary of the Division. The Greater Cleveland Biology Society will cooperate through the leadership of their president, Miss Nell C. Henry, in furnishing a group of teachers who will organize the discussion period growing out of the two papers presented. There will be other factors in the cooperation in this joint meeting.

All biology teachers within a reasonable distance of Cleveland are urged to attend this meeting which will be open to all members of the Central Association, The Greater Cleveland Biology Society, and *The National Association of Biology Teachers.* For details of the program, interested teachers may correspond with Mr. John C. Mayfield, The University of Chicago, or Miss Nell C. Henry, 732 East 105th St., Cleveland, Ohio.

Books

PARK, O., ALLEE, W. C., AND SHELFORD, V. E. *A Laboratory Introduction to Animal Ecology and Taxonomy.* The University of Chicago Press, 1939. 271 pp. $2.00.

"This book represents the work of three academic generations of teaching ecologists"—this, the first sentence in the foreword of the manual will give the student and layman an objective view into the practical teaching qualities and general information which the manual contains.

The first twenty-five pages offer a review of the basic divisions in the field of biology, much emphasis being placed on the interrelations of animals and their environment. Some thirty-five exercises are devised for the student, including: (a) how to construct a key, (b) a study of terrestrial animals, (c) a study of fresh water animals, (d) a general study of Faunal Percentages and Quadrats. The Synoptic Key, another division of the manual, gives accurate information on the descriptions and characteristics of animals of each phylum and on their habitats. A valuable fourteen-page glossary of technical terms is provided for the student. There are forty-seven diagrams which will prove helpful for identification purposes. The manual is bound in a unique style with a patent clasp which allows the book to open fully and lie flat on the desk. Criticism might be made of the rather fine print used throughout.

The writer considers this manual a practical, convenient, and thoughtfully constructed text, a sound treatise in the field of ecology and taxonomy.

S. W. ROBERTS,
East Stroudsburg State Teachers College,
East Stroudsburg, Pennsylvania

BRYAN, ARTHUR H., AND BRYAN, CHARLES. *Principles and Practice of Bacteriology.* Barnes and Noble, Inc., 1938. 267 pp. $2.25.

This text and manual of procedure is divided into three main sections. Part I discusses the history of general bacteriology, general characteristics of bacteria, how to prepare culture media, the inoculation of culture media, how bacteria are destroyed, and a practical method of study.

Part II is a study of pathogenic bacteria affecting human beings.

Part III deals with serology and immunology.

Fifteen pages are devoted to a glossary of technical terms, which will be of great aid to the student.

The arrangement of the book is practical, containing laboratory technique, 31 photographs, 101 illustrations, and provision for the student to take a minimum amount of notes in the back. The material is concise and definite, making it easy for the student or the layman to follow directions and apply his knowledge.

S. W. ROBERTS,
East Stroudsburg State Teachers College,
East Stroudsburg, Pennsylvania

ADELL, JAMES C., DUNHAM, OLIVE O., WELTON, LOUIS E. *Explorations in Biological Science.* 345 pp. Ginn and Co., Boston, 1937. $1.12. (One copy submitted for evaluation.)

The publishers present a current development in biology textbooks, a perishable, soft-covered $10\frac{3}{4}$ inch by $7\frac{3}{4}$ inch tape-bound book. Three holes have been punched on the binding side to assist in the use of a looseleaf cover. Non-coated paper and black and white typography

are used throughout. Line cuts, many of which are superbly executed, are featured. Only a few halftones supplement the copy. A small number of illustrations are sufficiently labeled, the rest are merely titled, plus an occasional legend.

The language is simple, and tends to use such phraseology as "Mystery of Pollen Grains, A Mental Motion Picture of the Development of Seeds . . ." Pronunciation keys are included.

The thirteen units utilize the following pattern of approach. The major principle to be studied is put in question form; about a page and a half of didactic information follows; the principles and generalization are listed, an excellent spelling and pronunciation drill follows; and then each individual problem is presented. The individual problem also follows a pattern, i.e., the problem is indicated; the elaboration of the stated problem is written up directly in the text; additional questions for classroom discussion are given space for outlining; and further projects are listed. The end of the unit has a *Student Aids* section consisting of a list of textbooks, mainly on a 9th year level, more questions and problems, and a long self mastery test. This is repeated for thirteen units and some 70 problems.

There is an even page space allotment to each of the thirteen units, amounting to an average of fifteen pages per unit. About six units are of a morphological nature covering such topics as Flowers, Insects, Cell Structure, Plant Classification, Animal Classification, and Vertebrate Relationship. Almost three units have a physiological development covering such principles as nutrition, digestion, circulation, and activities of the green plant. One unit elaborates Behavior, another Ecology, a third Health. Not more than twenty pages treat Genetics, including maturation of the gametes, mitosis, cleavage and eugenics. The authors include an excellent section on *Hobbies for Leisure Time.*

ALAN A. NATHANS

BROTHER H. CHARLES, F.S.C., *Biology.* The Bruce Publishing Company. Milwaukee, 1939. 408 pp. $1.72.

The Bruce Publishing Company has released a textbook superbly set up in almost every mechanical phase. It is $5\frac{1}{2} \times 8\frac{1}{2}$ inches with a blue-orange pebbled-finish cover. The text has a sturdy serviceable binding. The typography represents an extreme high in sharpness, readability and workmanship. The excellence of the typography is further enhanced by a high gloss carefully selected paper stock. The halftones and line cuts are well executed and carefully labeled. The book has the imprimatur of the Catholic Church.

This book, according to the preface, is to serve as a textbook of biology for Catholic high schools. Its most significant departure from the usual textbook type in science, is its close coordination between Catholic doctrine and science. While it does not moralize or indoctrinate, it emphasizes the relationship "Between God, man, and the other creatures." It offers the pupils two incentives for proper living—the natural and the divine. In controversial subjects such as evolution, it explains what Catholics may or may not believe. How desirable such a combination is in a science text is a moot question.

Brother H. Charles has stated in the preface that his purpose is to have students acquire an abiding interest in living things, to have respect for life and a disposition to protect and preserve it, to possess a desire to contribute to the betterment of what is faulty and undesirable in the environment in which they live, and to grow closer to the Divine

Author and Preserver of the life about them. That the author's purpose is constantly developed is quite evident throughout the book.

The factual material is more accurate than is usually found in first editions. The text includes thirty-three chapters following the traditional sequence rather than a unit idea plan of organization. Some of the chapter headings are: The Balance in Nature, The Cell, Man's System for Motion, Food, Anatomy and Hygiene of Our Digestive System, Our Circulation, The Regulation of Body Functions, Reproduction in Plants, Disease and Its Control, Variation and Heredity. A large part of the book is devoted to health and its preservation. Fifteen chapters of the thirty-three are specifically concerned with man.

Teacher helps and learning exercises are limited to a series of traditional end-of-chapter questions, a complete glossary including derivations of terms, and an adequate index. The labeling of the pictures, charts, and drawings is of unquestioned value. A Laboratory Manual and Teacher's Handbook are obtainable from the publisher.

Viewing the textbook in the light of present-day tendencies in science teaching and textbook construction one notes certain deficiencies. Compared with other biology books that have appeared during the last decade this book has around thirty per cent less material. The academic material is presented without consideration of problem solving procedures.

Alan A. Nathans (*Chairman*)
Robert S. Tolle
I. T. McDuffie

Stuart, Richard R. *The Anatomy of the Bull Frog.* Denoyer-Geppert Company. (Planographed.) Chicago, Illinois, 1939. 30 pp. $.50.

In his foreword, the author says that "this book was designed to meet a definite need for visual aid in the study of frog anatomy." It might be added—and an aid to the study of high school zoology.

Unlike many textbook drawings, those found in this manual of 30 pages are large and easily understood. The clearness and simplicity of these drawings compare more than favorably with the high school textbooks.

The drawings are large enough to be serviceable for individual pupil work, or, as in the teacher's case, to be thrown on a screen via the opaque projector.

It is suggested that these drawings combined with some simplified laboratory manual would satisfy most reasonable needs arising from the study of zoology in the high schools.

Wm. T. Rogers

Stiles, Karl A. *Handbook of Microscopic Characteristics of Tissues and Organs.* The Blakiston Company. 1940. $1.50.

A successful attempt to give the fundamentals of histology in an abbreviated form. The subject matter is treated in outline systematically and logically. There is a summation of the subject matter in tabular form at the close of the discussion of each division of tissues. The use of different sizes of type and the underlining of statements to indicate the relative importance of each division is commendable. It is fortunate and timely that the descriptions are based mainly upon tissues stained in hematoxylin and eosin, since such material is most likely to be available in general routine courses in biology. The handbook should be a time saver as a reference book for teachers of biology in secondary schools and junior colleges.

Claude Leist,
Kansas State Teachers College, Pittsburg, Kansas

LOWE, PAULINE E. *The Virginia Conservation Guide*, Bulletin of Sweet Briar College, Sweet Briar, Va. 1940. 48 pp. Paper.

This booklet contains a classified and annotated list of some of the most important books, bulletins, films, periodicals, Government agencies, and non-government agencies and organizations dealing with the various phases of conservation. Although special attention is given to conservation in Virginia, much of the information is of interest to the conservationist wherever he may reside.

BAILEY, JOHN WENDELL. *Biology at the University of Richmond.* Whittet & Shepperson, Richmond, Va. 1939. 194 pp. (Distributed by the author.) $2.50.

This is a detailed history of the Department of Biology of the University of Richmond, published in celebration of twenty-five years of service on the new campus and of the founding in 1914 of Westhampton College. There are numerous illustrations. The typography and binding are excellent. It should be of special interest to those who have been associated with the University of Richmond as students or instructors.

Living Specimens in the School Laboratory, 93 pp. Published and distributed by General Biological Supply House, Inc., Chicago, Ill. 1940. Paper, $1.00.

This booklet, written by members of the staff of the publisher, consists of a set of directions for the care and maintenance of the more commonly studied laboratory animals, ranging from Protozoa to birds and mammals. The material is a compilation of information taken from leaflets and bulletins already published by the company, with the addition of new material. In cases where several methods are available, the one requiring the least special equipment is described.

The data are summarized at the end in tabular form. A reference list of more than forty books is appended.

The booklet is printed on high grade glazed paper and is illustrated with numerous half tones and drawings. There is an index.

E. C. C.

SHOUP, CHARLES S., *An Annotated Bibliography of the Zoology of Tennessee.* Reprinted from the *American Midland Naturalist*, Vol. 21, No. 3: 583–635, 1939. For sale by Vanderbilt University Bookstore, Nashville, Tennessee, 50 cents.

This bibliography deals primarily with the systematic zoology of Tennessee and the Tennessee Valley Region. Approximately one thousand titles, arranged according to phyla, are listed. More than one-half of the titles relate to the molluscs, insects, and birds. There is an index of 216 localities mentioned in the bibliography. This list should prove useful to teachers and investigators interested in the zoology of the southeastern states. E. C. C.

NEEDHAM, JAMES G. *Introducing Insects, A Book for Beginners.* With illustrations by Ellen Edmonson. The Jaques Cattell Press, Lancaster, Pa. 1940. 129 pp. $1.50.

As indicated by its subtitle this book is for young persons. Its purpose is to stimulate interest in the collection and study of insects at first hand. This aim is accomplished by describing some of the most interesting things that insects do, and by pointing out a number of the basic laws of biology illustrated by these animals. A great deal of emphasis is placed on the economic importance of the group.

The style is conversational and narrative with technical terminology reduced to a minimum. Numerous original drawings are woven in with the word pictures. Practical methods are described for the collection, rearing, and studying of these arthropods. There is an index. The typography does credit to the publisher's skill.

E. C. C.

GOVERNMENT BULLETINS

Among the recent publications of the U. S. Department of Agriculture, which are of special interest to biology teachers, are the following:

1. Centipedes and millipedes in the house. 1939. 6p. il. Leaflet 192.
2. The Harlequin bug and its control. Revised 1939. 10p. il.
3. Domestic mosquitoes. 1939. 8p. il. Leaflet 186.
4. Mosquitoes of the Southeastern States. 1939. 91p. il. pl. Miscl. Pub. 336.
5. Preventing damage by termites or white ants. Revised 1939. 22p. il. Leaflet 1472.
6. Silverfish. Revised 1939. 4p. il. Leaflet 149.
7. The vegetable weevil. 1939. 26p. il. Agriculture Circular 530.
8. Clothes moths. Revised 1940. 8p. il. Leaflet 145.
9. Rabbit production. Revised 1939. 50p. il. Farmers' Bulletin 1730.
10. Famous trees. Revised 1939. 116p. il. Miscl. Pub. 295. ("Gives trees associated with notable persons, events, and places, and freak trees.")
11. Care of ornamental trees and shrubs. 1939. 80p. il. ("Gives information relating to adaptation, spacing, selection, culture, fertilization, soil acidity, pruning, pests, sprays and dusts, and special needs of some plants.") Farmers' Bulletin 1826.
12. Weeds, how to control them. Revised 1939. 29p. il. Farmers' Bulletin 660.
13. Forestry and permanent prosperity. Revised 1939. 21p. il. Miscl. Pub. 247.
14. Food and life, Yearbook of Agriculture. 1939. 1165p. il.

While the supply lasts, Government bulletins may be obtained free by writing to the Department at Washington or to your Congressman.

THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS ☐ NEW
MR. P. K. HOUDEK, *Sec'y-Treas.*, Robinson, Illinois ☐ RENEWAL

I hereby apply for membership in The National Association of Biology Teachers and enclose $1.00 as my annual membership dues 80c of which is for a year's subscription to The American Biology Teacher.

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